D5 DIGITAL TERMINAL SYSTEM

DESCRIPTION

DIGITAL TRANSMISSION SYSTEMS

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1. GENERAL

A. D5 Digital Terminal System

1.01 This practice provides an overall description of the D5 digital terminal system equipment. The major parts of the D5 digital terminal system are the D5 channel banks, the system controller, and the maintenance panel. Figure 1 is a block diagram showing a D5 digital terminal system and its interface with operations support systems.

1.02 This practice is reissued to provide new and updated descriptive information on the D5 digital terminal system. Most of the new information is a result of the generic 2.0 software package scheduled for release during the fourth quarter of 1986. Other changes reflect new or updated information not associated with any specific generic software package. Revision arrows are used to indicate significant changes.

1.03 The D5 digital terminal system offers cost advantages and new features not available with the previous D1, D2, D3, and D4 channel banks. Cost advantages can be realized because of generic multipurpose channel units, power savings, and space savings (up to 480 channels per 11-foot 6-inch bay). The D5 digital terminal system can be integrated into the operations support systems network. This enables centralized remote maintenance, circuit provisioning, and trouble sectionalization.

B. D5 Bank

1.04 The D5 bank, like the D1 through D4 banks, converts individual analog voice frequency circuits and data circuits into multiplexed digital signals for transmission over digital carrier facilities. The D5 bank is compatible with all previous D-banks except D1A, D1B, and D1C. ▶It is also compatible with the digroup terminal (DT), digital interface

frame (DIF), digital carrier trunk (DCT), digital access and cross-connect system (DACS), and digital multiplexers that accept DS1 or DS1C line rates. The D5 bank is capable of operation using the extended framing (Fe) format. Each D5 bank has 96 channels divided into 4 digroups of 24 channels each. It can operate at the DS1 or DS1C rate. The 4 digroups can be configured for all DS1 or DS1C operation or for a combination of DS1 and DS1C operation. The DS1C format is asynchronous equivalent to the D4 mode 2 format. The D5 bank is not compatible with the D4 mode 1 — DS1C synchronous format. Figure 6 shows a D5 bank with the two top digroups each configured for the DS1 rate and the two bottom digroups configured together for the DS1C rate.

C. D5 System Controller

1.05 The system controller (Fig. 7) directs all maintenance activities of the D5 bank. One system controller can maintain up to 20 D5 banks.

1.06 Some maintenance activities are programmed into the system controller for automatic action. Other maintenance activities are programmed for action upon maintenance personnel commands to the system controller. An input/output terminal, the craft interface unit (CIU), is used for inputting commands to or receiving messages from the system controller. The controller may be addressed by either a local CIU, a portable CIU, or a remote work station via a No. 2 Switching Control Center System (No. 2 SCCS) computer.

1.07 The automatic maintenance activities performed by the system controller consist of: (1) diagnostic loopback control, (2) execution of a diagnostic identifying faulty bank circuit pack(s) if the failure is in the bank, (3) continuous monitoring of all bank circuit packs, (4) periodic diagnostics, and (5) collection of digital facility performance data.

1.08 System controller maintenance activities that result from commands entered via a CIU consist of: (1) diagnostics on system peripherals or certain circuit packs, (2) digital access testing of any individual channel bank time slot (channel unit), (3) accessing any time slot to the maintenance panel for maintenance personnel to perform manual metallic or digital access testing, (4) electronically setting all channel unit and bank common unit options based on input commands, (5) electronically setting some channel unit options based on transponder signals, and (6) manually testing a dataport channel unit in the channel unit test slot (CUTS) on the maintenance shelf.

D. D5 Maintenance Panel

1.09 The maintenance panel (Fig. 8) is contained on the maintenance shelf. It is the main interface point, other than an input/output terminal, between the D5 system and maintenance personnel. It contains maintenance personnel/system interfaces such as alarm and status indicators and manual test jacks.

E. Network Operations Centers and Systems

1.10 Maintenance and provisioning functions on D5 equipment can be performed locally, or from centralized work centers with operations systems connected to the system controller. Depending on regional philosophy, these functions may be performed by the Facility Maintenance Administration Center (FMAC), the Network Terminal Equipment Center (NTEC), or the Switching Control Center (SCC). Both the NTEC and SCC use the No. 2 Switching Control Center System (No. 2 SCCS) computer. The No. 2 SCCS computer may be shared with the SCC or dedicated to D5 and other toll equipment with remote capabilities.

1.11 Other operations support systems that may interface with the D5 digital terminal system are: Switched Maintenance Access System (SMAS), Switched Access Remote Test System (SARTS), Trunks Integrated Records Keeping System (TIRKS), T-Carrier Administration System (TCAS), and Telecommunications Alarm Surveillance and Control System (TASC). Figure 2 depicts a planned D5 operations network showing the D5 interface to various operations support systems.

2. PHYSICAL DESCRIPTION

A. Channel Bank

2.01 The D5 channel bank (Fig. 6) measures 20.5 inches high and 21 inches wide. It has five shelves numbered 1 through 5 bottom to top, respectively. Shelf 5 (top shelf) contains the channel bank common circuit packs. Shelves 1, 2, 3, and 4 correspond to digroups 1, 2, 3, and 4. Each digroup shelf contains its digroup common circuit packs in slots X, Y, and Z (left side) and up to 24 channel units in slots 1 through 24.

2.02 The channel bank backplane contains primarily printed wiring and connectors. The bank and digroup common circuit pack connectors have 78 pins and the channel unit connectors have 52 pins. All channel bank circuit packs are 3.5 inches high and have a hinged faceplate serving as a latch. Each faceplate contains a label with an apparatus code or microcode, a common language equipment identifier (CLEI) code, a function code, and a bar code.

2.03 The only visual indicators at the channel bank are the fuses in the fuse panel and one light emitting diode (LED) on each power unit. If a power unit fails, its LED will light to indicate failure. Also, the channel bank contains no test access points except the test jacks on the voltage TEST circuit pack used to measure the bank voltages.

B. System Controller

2.04 The D5 system controller (Fig. 7) measures 40 inches high and 21 inches wide and has four shelves numbered 1 through 4, bottom to top, respectively. The system controller backplane contains 100-pin and 198-pin connectors. There are no test jacks or visual indicators on the system controller except for one LED on each power unit which lights if the power unit fails.

2.05 The system controller circuit packs are 7.5 inches high and have split faceplates with the top part serving as a latch. Each faceplate contains a label with an apparatus or microcode, a CLEI code, a function code, and a bar code.

C. Maintenance Panel and Maintenance Shelf

2.06 The maintenance shelf (Fig. 8) is 4 inches high and 21 inches wide. The left side of the shelf contains six system circuit packs, two for system timing, two for the maintenance panel display and controller interface operations, and two fuse units. The maintenance panel, located in the maintenance shelf, contains system maintenance interfaces such as alarm and status indicators, a system alphanumeric display, test jacks, timing supply jacks, and a CIU jack. The right side of the shelf contains the channel unit test slot (CUTS), which provides for manual testing dataport channel units.

D. Craft Interface Unit (CIU) Shelf

2.07 The CIU shelf is located directly above the maintenance shelf. It contains an optional bay integrated CIU input/output terminal and keyboard and an optional communciations panel.

E. Cartridge Recorder Shelf

2.08 The cartridge recorder shelf is located directly above the CIU shelf. It contains the cartridge recorder and associated power units.

F. Data Set Shelf

2.09 The data set shelf provides space for a data modem. The data modem is used for communication between a D5 system controller and the No. 2 SCCS computer for centralized remote operations.

G. Bay Arrangements

2.10 The D5 digital terminal system equipment can be mounted in 11-foot 6-inch, 9-foot, or 7-foot bays. Figure 3 shows the location of the system controller, channel banks, maintenance shelf, cartridge recorder, CIU, communications panel, data set shelf, and connector panel in an 11-foot 6-inch bay. The baffles between each bank serve as heat insulators.

2.11 The connector panel, located at the bottom of the system controller, contains connectors for the control links, the digital access links, and the metallic access links between the system controller and the channel banks.

H. Electrostatic Discharge (ESD) Considerations

2.12 Any integrated circuit on circuit pack can be damaged by static electricity that builds up within a work area, particularly in areas with low relative humidity. This static buildup on work surfaces and on personnel and their clothing is produced by the various charging effects of even simple movements and by contact between various objects.

2.13 As a rule, the greatest potential for electrostatic damage occurs in areas with the lowest relative humidity. But, because such damage can

occur anywhere, all personnel handling circuit packs should take the following precautions:

1. Since materials such as food wrappers, plastics, and styrofoam containers tend to generate static electricity, keep them away from all circuit packs.

2. Be sure to read all warning labels on bags and cartons before opening any packaging.

3. If possible, open all circuit packs at a static-safe work position using properly grounded wrist straps and table mats that can dissipate static electricity.

4. Whenever possible, wait to remove circuit packs from their protective antistatic packaging until it is time to insert them into a bay.

5. Never touch a circuit pack's components, conductors, or connector pins. Handle all circuit packs only by the faceplate or latch or by the top and bottom outermost edges.

6. When opening and handling circuit packs or when working on backplanes, always wear a grounded wrist strap or wear a heel strap and stand on a grounded floormat that can dissipate static electricity.

7. Always store and transport circuit packs in static-safe packages. (Shielding is not required unless specified.)

8. Whenever you remove circuit packs from a bay, immediately put them into static-safe packages.

9. Try to keep relative humidity above 20 percent.

2.14 D5 bays are equipped with static ground wrist straps and grounding jacks. The jacks for connecting the wrist straps are located at the baffles between each bank.

▶3. D5 SYSTEM TO MAINTENANCE PERSONNEL INTERFACE

3.01 Most activities on the D5 system are performed at the input/output terminal (CIU) and the maintenance panel. After circuit packs for a given bank and/or digroup are physically installed, all optioning and automatic testing activities are accomplished by commands entered at the local or remote CIU. The results of a given activity are reported by output messages which appear at the ALARMS AND STATUS panel and at the local, remote, and remote work center terminals. The output messages are in the form of a number and brief text. Also, output messages indicate system troubles ranging from out-of-tolerance conditions to major alarms.

3.02 The D5 input message can be started in two ways. The command verb can be entered into the CIU following the ready prompt (<) and the parameters of that verb will appear one at a time. If the command verb is not known, a (?) can be entered. The (?) will enable command verb selection with the aid of D5 menus. The menus are divided into five activities. They are ADMINISTRATION, ALARMS, CIRCUIT-ORDER, SYSTEM-CHECKS, and TEST-ACCESS.

3.03 The first menu to appear after entering a (?) is a list of the five activities. Once an activity is selected, its menu of associated command verbs appears. The activity menu and the command verbs menu for each activity are as follows:

(1) ACTIVITIES MENU

ADMINISTRATION — Contains activities required to configure major system elements, archive system data, and generate reports

ALARM — Contains activities involved with displaying alarms or modifying alarm operation

CIRCUIT-ORDER — Contains channel unit, carrier, and facility setting (option) activities

SYSTEM-CHECKS — Contains activities which verify system performance, isolate faults, and restore the system to normal operation

TEST-ACCESS — Contains activities required to establish metallic or digital test access to a selected channel unit. Test access appears at the system test jacks on the maintenance panel.

(2) COMMAND VERBS MENU FOR ADMINISTRATION ACTIVITY

BACKUP — Copies data base from bubble to tape.

CONFIGURE —Sets various system configuration constants such as terminal baud rate, controller identity, etc.

DISPLAY — Outputs reports.

INSTALL — Used to provision bank common circuit packs.

REMOVE — Used to disconnect bank common equipment from system controller service and permits removal without causing alarms.

RESTART — Reinitializes D5 system controller by complete reboot.

RETRIEVE — Copies data base from tape to bubble.

SCHEDULE — Sets time for or inhibits equipment performance report and data base backup operations.

SET-DATE — Enters date and time information into system controller.

DELETE-CLEI — Provides method to remove CLEI information in D5 system software. Available with generic 1.2 and later software. This command does not appear in this menu but it can be accessed from this menu.

UPDATE-CLEI — Provides method to add CLEI information in D5 system software. Available with generic 1.2 and later software. This command does not appear in this menu but it can be accessed from this menu.

(3) COMMAND VERBS MENU FOR ALARMS ACTIVITY

ALLOW — Enables local office audible and visual alarm circuitry

DISPLAY — Outputs systems data or reports

INHIBIT — Prevents local office audible and visual alarms (except power and fuse alarms) from occurring

TEST-MP — Test alarm indicators at maintenance panel

TEST-SC-ALM — Test controller timeout function

TEST-TELEM — Test E2 telemetry indicators.

(4) COMMAND VERBS MENU FOR CIRCUIT-ORDER ACTIVITY

ADJUST — Allows changes to digroup or channel unit provisioning parameters without the need for a disconnect and reprovision process.

BALANCE — Automatically adjusts the automatic balancing network in 2-wire channel units.

COPY — Allows provisioning of one or more banks, digroups, or channel units exactly like a singly designated bank, digroup, or channel unit. Available with generic 2.0 or later software.

DISC-CU — Disconnects channel unit from system controller service and permits removal from bank without causing alarms.

DISC-CXR — Disconnects digroup from system controller service and permits removal of digroup circuit packs without causing alarms.

MEASURE — Initiates system controller detection for transponder provisioning operation when dc detection is not available.

PROVISION — Establishes channel unit and digroup options.

SET-REDLINE-OFF — Removes special use channel designation.

SET-REDLINE-ON — Designates special use channel designation.

DISPLAY — Outputs reports.

CLEAR-FP — Clears the performance monitoring registers in the digroup formatter. This command does not appear in this menu but it can be accessed from this menu.

READ-FP — Issues facility performance monitoring report containing Out-of-Frame Counts, Receive Elastic Store Slips, Transmit Elastic Store Slips, and Errored Seconds. This command does not appear in this menu but it can be accessed from this menu.

(5) COMMAND VERBS MENU FOR SYSTEM-CHECKS ACTIVITY

AUDIT — Checks integrity of data base in bubble memory

DIAGNOSE — Performs various diagnostics on specified units

DISPLAY — Outputs reports

RECOVER — Reloads program for the system controller intelligent peripherals MAC, ATU, and OSSI, and restarts the peripherals. Also, recovers bank and common equipment following replacement.

(6) COMMAND VERBS MENU FOR TEST-ACCESS ACTIVITY

CONN-TA — Establishes a metallic and or digital connection from a channel unit to the system test jacks on the maintenance panel

DISC-TA — Removes metallic and or digital test access connection

SET-ABN-OFF, ON — Disconnects (OFF) or connects (ON) channel unit ABN. Disconnect (OFF) is used during manual testing to prevent circuit singing. Available with generic 2.0 or later software

SET SIGNAL — Forces channel unit signaling to a specified state.◀

4. FUNCTIONAL DESCRIPTION

4.01 The operation of the D5 digital terminal system involves four basic functions: (1) transmission, (2) command, (3) test access, and (4) synchronization (timing). The transmission function is performed within the D5 bank. The command and test access functions are originated in and controlled by the system controller which sends data into the bank controller and digroup controller for execution by the D5 bank equipment. The synchronization function is performed by D5 bank timing circuits. The Digital Data System (DDS) clock is provided to the bank timing circuits by the timing interface circuit packs located in the maintenance shelf. ▶Detailed information on D5 system synchronization is contained in this document and in Practice 855-351-103.◀

4.02 The D5 bank block diagram (Fig. 4) illustrates these four basic functions, showing bank transmission paths, command and test access interface to the system controller, and synchronization. It is used with the text to explain the operations of the D5 bank. A system controller block diagram (Fig. 5) is used to explain the operations of the system controller.

CHANNEL BANK EQUIPMENT OPERATION

A. Channel Unit

4.03 A D5 channel unit (Fig. 4) provides analog to digital conversion in the transmit path and digital to analog conversion in the receive path. It also provides metallic test access to SMAS, circuit signaling conversion, and dial pulse distortion correction. The channel unit provides and receives a unipolar pulse code modulation (PCM) bitstream consisting of voice or data encoded PCM, circuit signaling bits, and control bits.

4.04 Options in the D5 channel unit such as attenuation, slope equalization, and balance are electronically provisioned by commands from the system controller. There are no test jacks, controls, or indicators on the channel unit circuit packs. The only manual activity with the channel unit is to install it into or remove it from the bank. This is also true for all D5 bank circuit packs, except for the fuse units and the voltage TEST circuit pack which is used to measure the bank voltages.

4.05 The channel unit options may be set by one of two circuit provisioning modes (prescription or measurement). In the prescription mode, predetermined transmission and signaling option data (example: Work Order Record Details— WORD data) are

entered into the system controller either locally at the CIU or remotely at an SCCS work station. The system controller then sends commands that cause the channel unit to be optioned accordingly. The channel unit is then put into an "In Service" status by the controller and is ready for customer use. In the measurement mode, a transponder is connected to the circuit at the customer end. Tones are sent while the system controller measures each tone and automatically adjusts the channel unit gain, equalizer values, and balance (if required) to satisfy transmission requirements. However, prescription options must be entered into the channel unit before a transponder can be used.

4.06 Some channel unit applications (message and special service) are grouped generically into seven basic types of channel units. Other special service applications such as dataport require individual channel units. However, due to generic grouping, the number of D5 channel units required for all types of services is less than the number required for the previous types of D-banks. Table A lists the seven generic type units with their applications and the dataport units.

B. Digroup Controller (DC) — AEK11

4.07 The digroup controller circuit pack (Fig. 4) provides digital test access on a per-channel basis to the system controller. It contains the channel counter circuitry which provides a channel counting sequence to match that of the far end bank; i.e., D1D, D2, or D3-D4-D5. Command signals from the system controller are sent via the bank controller to the digroup controller. The channel counting option is electronically provisioned by commands from the system controller.

C. Line Interface Function

4.08 The D5 channel bank can operate in the DS1 and/or DS1C digital signal (DS) line rates. The line interface function for each of these DS rates is performed by two circuit packs - a digroup formatter (DF) and a facility interface (FI). A digroup formatter (AEK10) (MC97027) is always required in slot Y of each digroup shelf regardless of the DS rate of operation. However, there are two types of facility interface circuit packs and the type required depends on the DS rate. The DS rates and associated facility interface circuit packs are as follows: DS1 — FI-1 (AEK7) or DS1C — FI-1C (AEK8). Table B shows the facility interface circuit pack configuration for each DS rate.

4.09 The digroup formatter (DF) performs the following line interface functions: (1) provides format conversion between application format (line) and the digroup format including framing and signaling insertion and extraction; (2) provides optional zero code suppression; (3) provides independent digroup diagnostic loopback when a Carrier Group Alarm (CGA) occurs; (4) provides elastic store similar to the D4 syndes unit; and (5) provides loop timing capability on a digroup basis.

4.10 The facility interface (FI) circuit packs perform the following line interface functions: (1) recovers clock from the receive line signal; (2) provides line equalizers electronically selected by the system controller; and (3) provides system loopback and sends an all ones signal to the far end upon command from the system controller. In addition, the FI-1C circuit pack performs DS1C line rate multiplexer/demultiplexer and framing bit insertion operations.

D. Bank Controller (BC) — MC97026

4.11 The bank controller (Fig. 4) processes commands from the system controller and passes commands to the bank circuit packs. It constantly monitors the provisioning settings (options) in all channel and common units and reports to the system controller if deviations from the original settings or circuit malfunctions occur. ▶It also monitors for bank power supply failures.◀

E. Bank Clock (BCLK) — AEK2

4.12 The bank clock (Fig. 4) establishes system clock for bank timing. It supports synchronization capability for the four digroups by providing 4.096 MHz clock and superframe (24 frame) sync. It provides local timing with an internal free-running clock or it works with the bank synchronizer (BS-1) to distribute external clock when dataport timing is required.

F. Bank Synchronizer (BS-1) — AEK4

4.13 The bank synchronizer circuit pack distributes dataport DDS clock signals throughout the D5 bank as shown in Fig. 4. The BS-1 is required when dataport DDS synchronization is needed. Ex-

ternal clock is supplied to the BS-1 through the timing interface circuit packs located in the maintenance shelf.

G. Bank Digital Access (BDA)—AEK3

4.14 Under direction of the system controller, the bank digital access circuit pack (Fig. 4) selects a digroup containing a channel to be routed for system controller digital test access. The system controller performs digital access testing on a per-channel basis.

H. 323A and 323C Power Units and 40A Fuse Block

4.15 The D5 bank has two types of power units. Figure 6 shows these units mounted in the top shelf. The two 323A units provide +5 volts and the 323C unit provides −5 volts to the bank.

4.16 The 40A fuse block (Fig. 6) contains the bank fuses and fuse alarm circuitry. Eight fuses consisting of four types are mounted on the block. Table C lists the types of fuses, their electrical rating, and function. The fuses are code designated 80-type and 81-type. The 80-type fuses are current rated to 5 amperes maximum and have indicating and alarming features. The 81-type fuse is current rated to 10 amperes maximum with no direct indicating or alarming feature. The 81-type fuse is alarmed by providing an 80-type fuse in parallel.

I. Voltage TEST—AEK14

4.17 The voltage TEST circuit pack is contained in slot W of the top shelf. It is used for measuring the channel bank voltages. It is optional and can be installed or removed any time with no effect on channel bank operation.

D5 SYSTEM CONTROLLER EQUIPMENT OPERATION

A. Execution Unit (EU)—MC97019 and MC97020A1B

4.18 The execution unit (Fig. 5) is the data processing core of the system controller. It consists of two circuit packs each containing a microprocessor and associated memory that work together to coordinate the exchange and manipulation of data between the elements of the system controller. The execution unit contains a 16-bit microprocessor which addresses, fetches, and executes program code from the program data store.

B. Program Data Store (PDSE)—AEL16 and AEL27

4.19 ▶The program data store circuit pack (Fig. 5) is the random access memory (RAM) used for program storage. All program software used to control operations within the execution unit is loaded into the PDSE. All program instructions stored in the PDSE are volatile in that the data can be lost during power failure. However, if this occurs, the RAM program will be automatically restored from the system generic tape. Each PDSE circuit pack is capable of approximately 524,000 bytes of memory with each byte containing 8 bits of information plus a parity bit.◀

C. Magnetic Bubble Memory (MBM)—MBM01 or AEL25 and Magnetic Bubble Memory Controller (MBA) MBA01 or AEL24

4.20 The magnetic bubble memory circuit packs (Fig. 5) contain the magnetic bubble memory devices. It is the primary system data base for all provisioning data (channel unit options) and (bank common unit options). Bubble memory is nonvolatile, meaning it does not lose its contents during power failure.

4.21 The magnetic bubble memory controller circuit pack (Fig. 5) acts as a data buffer for transferring data to or from the bubble memory circuit packs. The MBA controls the bubble memory subsystem through a serial communication link to the execution unit via the control link interface circuitry.

D. Cartridge Recorder

4.22 The cartridge recorder (Fig. 5) contains a current generic tape of all program information. The tape is the primary backup for the system software. It is used to reprogram the RAM if the system software is to be changed or if the system software is lost during a power failure. ▶The tape also contains a backup copy of the bubble memory data base information which can be used to reprogram the bubble memory data base (channel unit and bank options information) if a BACKUP operation has been performed. A spare tape containing the current generic program information is supplied. The spare tape can also contain the bubble memory data base information if a BACKUP operation is performed. The spare tape can be stored in a storage compartment in the cartridge recorder panel.◀

E. Control Link Interface (CLA and CLB)—AEL4 and AEL5

4.23 The control link interface consists of two circuit packs (CLA and CLB) (Fig. 5). They work together to provide the communications link between the execution unit and all system peripherals except the cartridge recorder and craft interface unit.

F. Control Link Driver (CLD)—AEL6

4.24 The control link driver circuit packs (Fig. 5) perform a concentrator or fan-out/fan-in function. Each control link driver contains 16 separate links into the system peripherals. The CLD concentrates the 16 links to one link into the control link interface for communication with the execution unit.

G. Multi-Application Peripheral Processor (MAPP)—MC97023

4.25 Each multi-application peripheral processor circuit pack (Fig. 5) contains a general purpose processor circuit. The processor circuit has a microprocessor and associated memory which serves as a control interface to the automatic test unit, the SMAS access control, and the operational support systems interface circuit packs.

H. SMAS Access Control 2 (SAC2)—MC97021

4.26 The SMAS access control 2 circuit pack (Fig. 5) is the D5 system interface to SARTS/SMAS test control. The SAC2 receives and interprets commands from SMAS (such as channel to be tested), responds to the system controller accordingly via the MAPP, and replies to SMAS.

I. SMAS Access Control 1 (SAC1)—AEL18

4.27 The SMAS access control 1 circuit pack (Fig. 5) provides an interface between the SAC2 and the SMAS 47 lead control bus. It converts the SMAS 48-volt dc or ground addressing signals into digital logic levels for the SAC2 and, conversely, the digital logic levels from the SAC2 into ground relay signals for SMAS. The SAC1 contains protection diodes to eliminate transient signals generated by the SMAS equipment.

J. Operations Support Systems Interface (OSSI)—AEL19

4.28 The operations support systems interface circuit pack (Fig. 5) handles communications to the various support systems such as TCAS, TASC, and No. 2 SCCS.

K. Automatic Test Unit (ATU1)—MC97024

4.29 The automatic test unit circuit pack (Fig. 5) generates and analyzes transmission signals for internal digital testing and for transponder provisioning. It contains a digital signal processor circuit and associated memory. Upon command of the execution unit, the ATU1 provides PCM and frequency shift keying communication between the system controller via the MAPP and a transponder at the customer location.

L. Test Access Controller (TAC)—MC97022 and AEL10

4.30 The test access controller (Fig. 5) consists of two circuit packs, TAC1 and TAC2, that control information between the execution unit and the testing circuit packs. It extracts a time slot (channel) to be tested from a digroup bitstream and sends this time slot to the automatic test unit or converts it to analog for test access at the maintenance panel. The TAC controls and monitors signaling information on the channel to be tested.

M. System Metallic Access (SMA)—AEL7

4.31 The system metallic access circuit packs (Fig. 5) route the metallic test access buses to SARTS/SMAS or to the system controller test circuits for test access at the maintenance panel. The SMA provides the required SMAS functions of bridging, looping, and splitting.

N. Metallic Interface Unit (MI)—AEL17

4.32 The metallic interface unit circuit pack (Fig. 5) contains precision networks that are used for calibrating the automatic balance network (ABN). It routes the metallic access buses to either the test jacks at the maintenance panel or to the ATU and TAC.

O. Digroup Selector (DS)—AEL21

4.33 The digroup selector circuit packs (Fig. 5) each contain metallic buses from ten digroups. Under command of the execution unit, the DS circuit packs choose one of two buses shared by ten digroup buses and connect it to one of two system test buses. This provides up to two simultaneous metallic test accesses per ten digroups shared by SMAS and the D5 maintenance panel.

P. System Digital Access (SDA)—AEL11

4.34 The system digital access circuit packs (Fig. 5) terminate all digital test signal buses from the D5 banks. The SDA chooses zero, one, or two signals to go to the test access controller for digital testing.

Q. Maintenance Panel Alarms (MPA)—AEL14

4.35 The maintenance panel alarms circuit pack (Fig. 5) provides relay contacts for local and optional remote office alarms. It also drives the alarm LEDs on the maintenance panel, and provides alarm cutoff (ACO) logic.

R. Maintenance Panel Controller (MPC)—MC97025

4.36 The maintenance panel controller circuit pack (Fig. 5) drives various status and test LEDs on the maintenance panel and conditions test set clock signals from the timing interface unit. It also provides the following: a reset signal to the system controller when the RESET button is depressed, logic level conversion for CIU signals, service request logic for the maintenance panel, timing circuitry status to the system controller, and a "dead man" detector that checks the integrity of the execution unit.

S. Maintenance Panel Display (MPD)—AEK12

4.37 The maintenance panel display circuit pack (Fig. 5), located in the maintenance shelf, drives the maintenance panel alphanumeric display. It also receives reset signals which blank the alphanumeric display in the event of manual reset.

T. Craft Interface Unit—(CIU)

4.38 The CIU is the video display input/output terminal used to communicate with the D5 system. There are three optional arrangements for equipping the D5 system with a CIU: integrated into the controller bay, portable, or distant. Several types of commercially available CIUs may be used. However, there are certain requirements and restrictions associated with each of these options which are covered in the D5 ordering guide.

U. Data Set Shelf

4.39 The data set shelf provides space for a data modem for communication to the No. 2 SCCS computer. The private line between the data modem and the No. 2 SCCS computer should be full duplex, 1200 baud, and 3002 channel conditioning.

V. Power Units and 40B—40C Fuse Blocks

4.40 ▶Figure 8 shows the location of the system controller power units. There are three 333A units which provide +5 volts and one 333B unit which provides +24 and +12 volts to the bubble memory. The 333B power unit is replaced with an AEL26 power cross connect (PCC) pack when using the new AEL24 and AEL25 bubble memory.◀

4.41 The cartridge recorder shelf contains two power units. The 131AD1 unit provides +18 and −18 volts and the AJC1 unit provides +5 volts to the cartridge recorder.

4.42 The maintenance shelf contains an AEK13 Maintenance Panel Power (MPP) circuit pack which provides +5 volts to the maintenance shelf. Two fuse block plug-ins, a 40B and 40C, are also contained in the maintenance shelf. Each fuse block contains the system controller and associated equipment fuses and fuse alarm circuitry. Table C lists the types of fuses, their electrical rating, and function for each fuse block.

5. D5 DIGITAL TERMINAL SYSTEM SYNCHRONIZATION

▶5.01 The D5 system must operate in a synchronous mode; i.e., within the digroup, the transmit PCM and the receive PCM must be timed to the same clock source. Synchronization in D5 takes place at three levels: system, bank, and digroup. The different applications and options are described below. Refer to Practice 855-351-103 for additional synchronization information.

A. D5 System External Composite Clock

5.02 An external composite clock is always required for the two AEK6 timing interface circuit packs. The AEK6 packs supply timing to each AEK2 bank clock when an AEK4 bank synchronizer is provided in the bank. Two external composite clocks must be supplied to every D5 system (one to each AEK6 pack). The absence of one clock source results in a minor alarm. The absence of both clock sources results in a critical alarm. There are several sources of external clock which can be used to supply composite clock. Also, a J98726W synchronization distribution expander (SDE) can be used to supply composite clock. The SDE receives its composite clock from the local office timing supply or from an incoming T1 line using a bridging repeater.

B. D5 Bank Timing

5.03 When provisioning a bank using the INSTALL command, there are two option choices for the "BS TYPE=" prompt. They are BS TYPE= NONE or 1. If "NONE" is selected, the AEK2 bank clock's 4 MHz clock will be free running and no bank synchronizer (AEK4) circuit pack is needed. However, if NONE is selected, the far end digroup must be loop-timed to maintain synchronization. This application applies to voice frequency transmission only (no dataports in bank). If "1" is selected, the AEK2 bank clock's 4 MHz clock will be timed from an external composite clock source and the far end bank digroups must either be loop timed or synchronized to the same clock source to maintain synchronous operation. In this configuration, a BS-1 AEK4 bank synchronizer circuit pack must be installed in the bank. Regardless of the option selected (NONE or 1), the D5 system timing interface (AEK6) circuit packs must be installed and connected to an external composite clock (CC). For services requiring external clock such as dataport, option "1" must be selected.

C. D5 Digroup Timing

5.04 When provisioning a digroup using the PROVISION command, there are two option choices for the "TMG=" prompt. They are TMG= EXT or LP for external or loop. These options apply to the AEK7 (FI-1) or AEK8 (FI-1C) facility interface circuit packs and to the AEK10 digroup formatter circuit pack. If "EXT" is selected, that digroup's transmit 4-MHz clock and transmit 1.544 MHz clock will be timed from the AEK2 bank clock. If "LP" is selected, that digroup's transmit 4 MHz clock and transmit 1.544 MHz clock will be timed from the incoming T-line bit stream. Any digroup may be set to "EXT" or "LP" timing independent of the other three digroups.◀

D. Timing Interface (TI)—AEK6

5.05 The two timing interface circuit packs are contained in the maintenance shelf (Fig. 7). Their operation is completely independent of system controller operation; therefore, they will continue to function if the system controller experiences problems. ▶Only one timing interface circuit pack provides timing to the banks at any one time. The other is a backup in case of failure. Also, the timing interface packs are separately fused to reduce the chance of a service interruption caused by a power problem. The maintenance panel controller (MPC) circuit pack, contained in the system controller (Fig. 5), reports the condition of the timing interface circuitry to the system controller. Failure of one timing interface circuit pack will not affect service but will cause a minor alarm. Failure of both timing interface circuit packs will cause service interruption to those digroups optioned for external timing and will cause a critical alarm.◀ The absence of an output timing signal from either timing interface circuit pack will cause an LED to light on that pack. Figure 5 shows the timing interface link with the system controller.

6. ALARMS AND TROUBLE ANALYSIS

A. System Alarms

6.01 Four types of alarm capabilities are built into the D5 digital terminal system. They are critical, major, minor, and system controller. The indicators for each are contained on the maintenance panel. The alarms are described as follows:

(1) ***Critical Alarm:*** A critical alarm, which lights a red CR LED on the maintenance panel, is generated if both timing interface circuit packs or their input signals fail. A critical alarm does not result in a carrier group alarm (CGA) condition in the D5 digital terminal system.

(2) ***Major Alarm:*** A major alarm, which lights a red MJ LED on the maintenance panel, is generated by any of the following conditions.

(a) ***Carrier Failure:*** This results from loss of incoming line signal. It is equivalent to the D4 AR (red) alarm condition "loss of incoming signal" or the D4 AY (yellow) alarm condition transmitted from far end "resulting from far end loss of incoming signal." If the major alarm results from an AR or AY condition, automatic system loopback and diagnostic testing by the system controller will result. The maintenance panel display will indicate the type of alarm condition AR (RED) or AY (YEL) and the results of the loopback diagnostic (equipment or facility problem). This alarm will cause a CGA condition.

(b) ***Power Failure:*** This will cause a major alarm and a CGA condition may or may not result depending on the type of power loss.

(3) ***Minor Alarm:*** A minor alarm, which lights a yellow MN LED on the maintenance panel, is generated by any of the following conditions.

(a) ***Individual Circuit Failure:*** This does not result in a CGA condition but can affect service on an individual circuit basis of from 1 to 23 channels. Certain types of channel unit faults can cause this situation.

(b) ***Timing Interface Failure:*** If one timing interface circuit pack fails, a minor alarm will result. Service will not be affected on DDS channels because of the back-up timing interface circuit pack.

(c) ***Automatic Diagnostics:*** This results from out-of-tolerance conditions detected during system controller periodic automatic diagnostics of system equipment such as the bubble memory or channel bank circuit packs. No CGA condition will result.

(4) ***System Controller Alarm:*** A system controller alarm results from a system controller failure. This will light the yellow SC lamp and the red HALT lamp on the maintenance panel. The CR, MJ, and MN alarm lamps will also light, but no CGA condition will result and service is not interrupted at the D5 banks.

6.02 The maintenance panel contains an ALARMS AND STATUS display which conveys D5 system alarm or diagnostic maintenance information. It can display up to 20 alphanumeric characters and can scroll up to 128 alarm events. This is used in conjunction with or in place of the diagnostic display from the CIU.

6.03 Trouble indicator LEDs are contained on various system circuit packs. Every power unit for both the controller and the channel bank contains an LED which lights if that power unit fails. Also, each timing interface circuit pack contains an LED that lights during failure.

B. System Trouble Analysis

6.04 The D5 system maintenance testing operations are divided into three categories:

- Automatic testing
- Technician initiated system controller testing
- Technician manual testing at the maintenance panel.

6.05 Automatic testing by the system controller is a continuous operation. This involves constant monitoring of the provisioning settings in all channel units and common units for changes in the original settings. If the provisioning settings change, a minor alarm is generated unless the settings are automatically corrected by the controller. ⧫If the line signal fails or digroup common equipment fails, a major alarm is generated and an automatic fast loopback occurs. The controller will then identify the location of the failure—bank/digroup or line facility.

6.06 The system controller can perform various diagnostic routines when a technician enters a DIAGNOSE command at the CIU. The diagnostics performed depend on the equipment locations entered at the CIU. For example, a DIAGNOSE channel unit location tests the channel unit net loss, gain tracking, 0 and −40 TLP distortion, idle circuit noise, equalizer slope, and automatic balance network (ABN) training (if applicable).⧫

6.07 Manual test access, either digital or metallic, is available to each channel. A channel to be tested can be processed by the system controller for manual test access at the test access jacks on the maintenance panel.

6.08 Manual metallic testing allows the technician to test at the METALLIC test jacks on the maintenance panel for the proper signaling and transmission parameters to and from the drop facility. Manual digital or transmission level point (TLP) testing allows the technician to test the digital output signal of a channel unit at the digital test jacks on the maintenance panel. However, the digital output signal to be tested is first converted by the system controller to an analog signal and then accessed at the maintenance panel for testing. This allows the use of existing analog test equipment to, in effect, test the digital signal.

6.09 Systems with 2.0 or later generic software have an "insertion detection" and test access audit feature. The insertion detection feature allows an automatic diagnostic by the system controller on channel units and recovery of most bank circuit packs at the time they are installed into the bank. The results of the diagnostic are reported at the maintenance panel display and at the CIU. If a bank, digroup, or channel unit slot is preprovisioned (locations provisioned before circuit packs are installed), the insertion detection feature will automatically provision the circuit packs when they are installed. However, the automatic channel unit diagnostic must be successful before the channel units are automatically provisioned. The test access audit feature allows automatic recovery of most test access circuit packs at the time they are installed into the system controller.

6.10 The maintenance panel contains two timing supply jacks. These jacks provide access to the system timing pulses for connection to any test equipment that requires timing synchronization such as the dataport test equipment.

6.11 The maintenance shelf contains a channel unit test slot (CUTS) where manual tests can be performed on dataport channel units.

6.12 Another aspect of D5 system maintenance and trouble analysis is system controller status. This is indicated at the maintenance panel by status LEDs - RUN, LOAD, and HALT. The RUN LED is lighted when the system controller is operating normally. The LOAD LED is lighted when the system controller is being restarted. The HALT LED is lighted when the system controller is out of service. In the event of system controller failure, it may be reactivated after repair by a RESET switch also on the maintenance panel. A RESTART command entered via the CIU can be used to reactivate the system controller if it is in service (RUN lamp lighted on maintenance panel). During reactivation, the cartridge recorder will load the controller RAM. If the system controller fails, it will attempt to reset itself up to four times before an alarm is activated and manual intervention is necessary.

6.13 A communications panel can be mounted with the D5 digital terminal system hardware in the CIU shelf. This allows order wire and other types of communications from the D5 bank locations.

C. Customer Support Tools

6.14 There are various customer support tools available for D5 system maintenance. These tools are called "COACH" for Customized Online Aids for Customer Help. The following tools are available:

(1) ***Diagnostic Dictionary***—The diagnostic dictionary tool gives the user access to previously detected symptoms, problems, temporary fixes, cautions, and solutions. These may be usable in diagnosing, correcting, or avoiding a system problem.

(2) ***Compatibility Data***—The compatibility data tool gives the user access to hardware configuration data that is compatible to a user specified software generic.

(3) ***News and Bulletin***—The news and bulletin tool allows the user to process news and bulletin information. News consists of messages which may be of general interest to the user. Bulletins contain information of a more urgent nature.

6.15 The COACH tools are available online to the user. A login identification and password must be obtained to gain access to COACH. Information for obtaining and using a COACH login is contained in the D5 Customer Support Tools User's Guide.

7. DRAWINGS AND REFERENCES

7.01 The D5 digital terminal system equipment is coded in the J98743 series. However, the individual circuit packs of the D5 digital terminal system are not individually J-coded but are apparatus coded

or microcoded. Table D lists the D5 bank circuit packs by name and apparatus code or microcode. Table E lists the system controller circuit packs by name and apparatus code or microcode. Table F lists the D5 system equipment SD, ED, or KS numbers.

7.02 Other documents relating to the D5 digital terminal system are listed below.

PRACTICE	TITLE
103-494-111	J99403TA Transponder Description and Operation
365-190-000	D5 Digital Terminal System Task Oriented Practices (TOP)—Generic 1.1 Software
365-190-002	D5 Digital Terminal System Task Oriented Practices (TOP)—Generic 2.0 Software
365-190-105	D5 Generic Channel Units Description
365-190-110	D5 Dataport Channel Units Description
801-505-159	J Specification
855-351-103	D1, D2, D3, D4, and D5 Channel Banks—Application Engineering—Carrier Engineering
855-351-120	D5 Channel Units Application Engineering
855-351-125	D5 Digital Terminal System Input/Output Manual Generic 2.0 Software
	D5 Ordering Guides
E8205	ED-8C541-10 For New Systems
E8206	ED-8C541-11 For Additions
E8207	ED-8C541-12 For Plug-Ins

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➡TABLE A⬅

CHANNEL UNIT TYPES AND APPLICATIONS

APPARATUS CODE	CHANNEL UNIT TYPE	FUNCTIONS
AEK20* or AEK20B	Source Current 2W-1	DPO, DPMO, SDPO, 2FXS, 2FXS/GT, 2FXS/LS, and 2TO (with sealing current)
AEK21	Sink Current 2W-2	DPT, RSCO, 2FXO, 2FXO/GT, 2FXO/LS, and 2TO (without sealing current)
AEK22	No Sink or Source Current 4W-0	4E&M, 4E&MER, PLR
AEK23	Source Current 4W-1	4FXS, 4TO, 4ETO, 4LSXO, 4DX, and [4TO and 4ETO (with sealing current)]
AEK24	Sink Current 4W-2	4FXO, 4TDM, and [4TO and 4ETO (without sealing current)]
AEK25	No Sink or Source Current 2W-0	2E&M, 2E&M6
AEK26	Dataport	OCU DP — 2.4, 4.8, 9.6, 56 kb/s
AEK27	Dataport	DSØ DP
AEK30	4-Wire Single Frequency	4SF (4E&M, 4FXO, 4FXS, 4TO) All with or without equalization

* For AEK20 and AEK20B applications, refer to AT&T Practice 855-351-120.

➡TABLE B⬅

FACILITY INTERFACE CIRCUIT PACK CONFIGURATION — DS RATE

BANK DIGROUP OR SHELF/SLOT	FACILITY INTERFACE CIRCUIT PACK	
	DS1 RATE	DS1C RATE*
4/X	FI-1	Vacant
3/X	FI-1	FI-1C
2/X	FI-1	Vacant
1/X	FI-1	FI-1C

* For DS1C operation, digroups are paired as follows: 1 with 2 and/or 3 with 4.

➡TABLE C⬅

D5 SYSTEM FUSES

LOCATION	TYPE	RATING	DESIGNATION
Bank — 40A	80G	0.5 Amp	48 PILOT, 20 Hz
	80C	3 Amp	–48 –1, –2, –3, –4
	80D	5 Amp	PU (Power Unit)
	81A	10 Amp	48 MAIN
Maintenance Shelf — 40B	80G	0.5 Amp	PILOT, 20 Hz, TAPE TIMSA
	80B	2 Amp	TAPE, PUSC1T, PUMSE
	81B	7.5 Amp	MAIN
Maintenance Shelf — 40C	80G	0.5 Amp	PILOT, TIMSB
	81B	7.5 Amp	PUSC2A, PUSC2L, PUSC3M

➡TABLE D⬅

D5 CHANNEL BANK CIRCUIT PACKS

CIRCUIT PACK APPARATUS OR MICROCODE	CIRCUIT PACK NAME
MC97026	Bank Controller
AEK2 or AEK2B	Bank Clock
AEK3	Bank Digital Access
AEK4	Bank Synchronizer —1
AEK7	Facility Interface — 1 (DS1)
AEK8	Facility Interface — 1C (DS1C)
MC97027-AEK10	Digroup Formatter
AEK11	Digroup Controller
AEK14	Voltage Test
323A	+5 Volts Power Unit — PU +5
323C	–5 Volts Power Unit — PU –5
40A	Fuse Block

➡TABLE E⬅

D5 SYSTEM CONTROLLER CIRCUIT PACKS

CIRCUIT PACK APPARATUS OR MICROCODE	CIRCUIT PACK NAME
MC97019	Execution Unit 1
MC97020A1B	Execution Unit 2
AEL4	Control Link A
AEL5	Control Link B
AEL6	Control Link Driver
AEL7	System Metallic Access
MC97021	SMAS Access Control 2
MC97022	Test Access Control 1
AEL10	Test Access Control 2
AEL11	System Digital Access
MC97023	Multi-Application Peripheral Processor
MC97024	Automatic Test Unit 1
AEL14	Maintenance Panel Alarm
MC97025	Maintenance Panel Controller
AEL16 and AEL27	Program Data Store E
AEL17	Metallic Interface
AEL18	SMAS Access Control 1
AEL19	Operational Support Systems 1
AEL21	Digroup Selector
AEK6*	Timing Interface
AEK12*	Maintenance Panel Display
AEK13*	Maintenance Panel Power
MBM01 or MBM AEL25	Magnetic Bubble Memory
MBA01 or MBC AEL24	Magnetic Bubble Controller
333A	+5 Volts Power Unit
333B or AEL26	+24/+12 Volts Power Unit or Power Cross Connect
AJC1†	Cartridge Power Supply
131AD1†	+18/–18 Volts Power Unit
40B*	Maintenance Panel Fuse Block
40C*	Controller Fuse Block

* Located in maintenance shelf

† Located in cartridge recorder shelf

TABLE F

D5 SYSTEM EQUIPMENT SD/KS NUMBER

EQUIPMENT	SD/ED/J NUMBER
D5 System Application	SD-7C360-01
D5 Bank	SD-7C361-01
D5 System Controller	SD-7C362-01
D5 Maintenance Shelf	SD-7C363-01
D5 Maintenance Panel	ED-7C469-30
Transponder	SD-7C106-01
Cartridge Recorder Shelf	SD-7C364-01
Cartridge Tape (with Program Generic)	J98743AS
Craft Interface Unit Shelf	SD-7C360-01
Sliding Keyboard Shelf	ED-7C478-50
Communication Panel	SD-54505-01
Data Set Shelf	SD-7C360-01

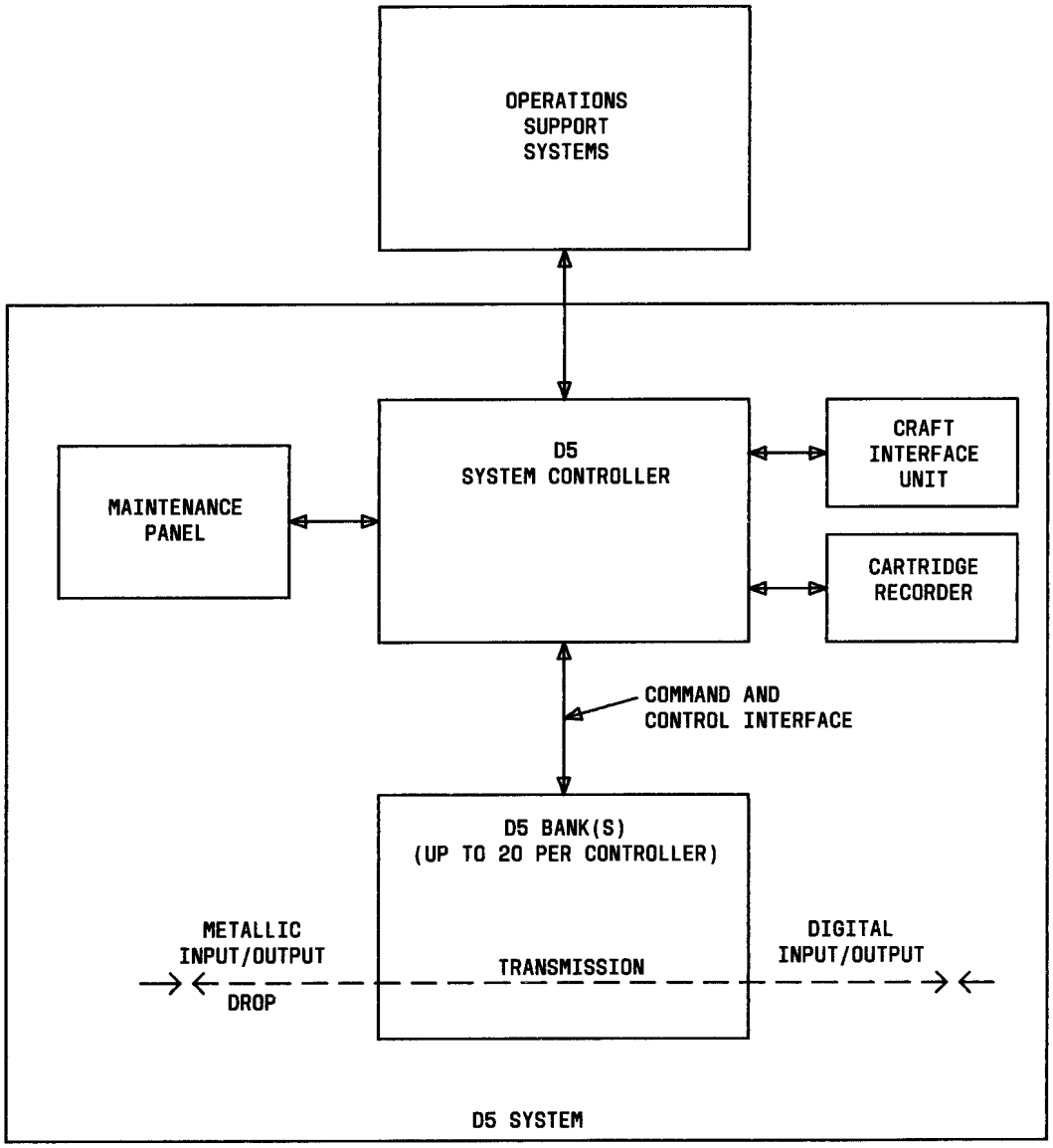

Fig. 1—D5 Digital Terminal System/Operations Support Interface

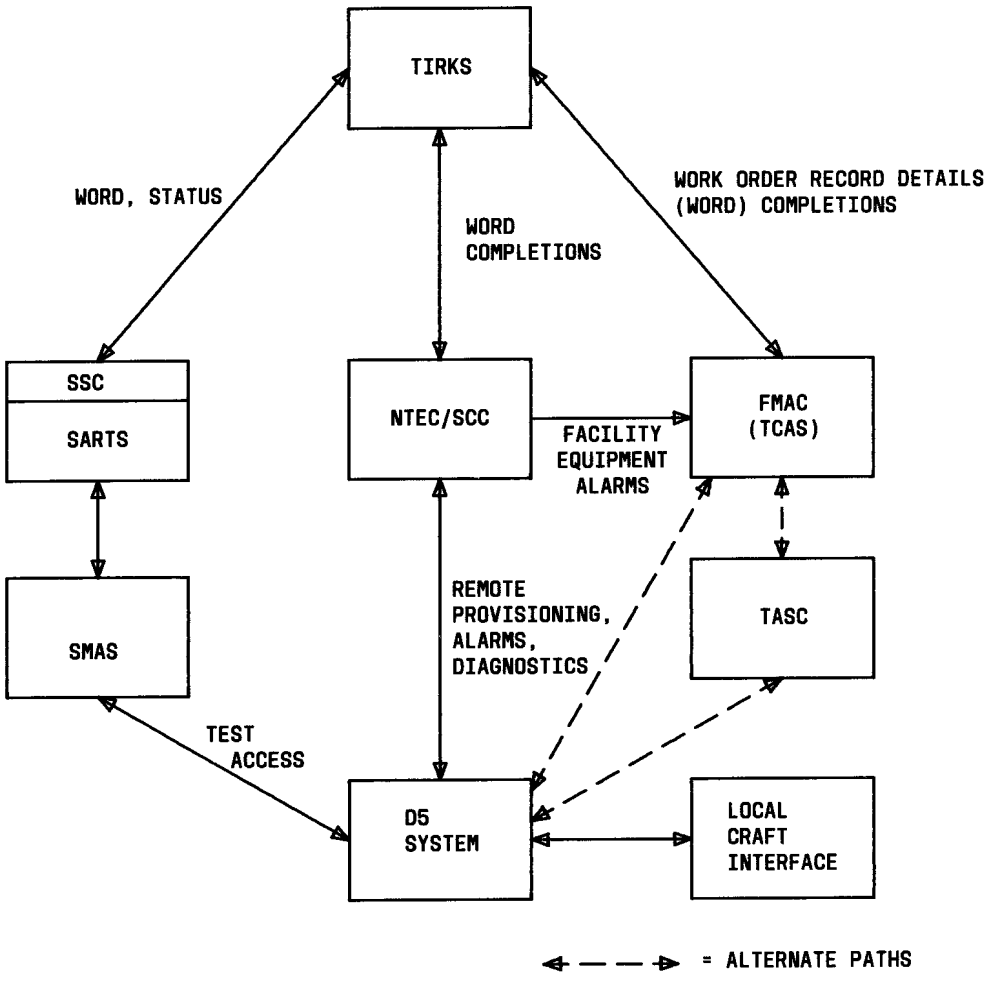

Fig. 2—D5 Operations Network

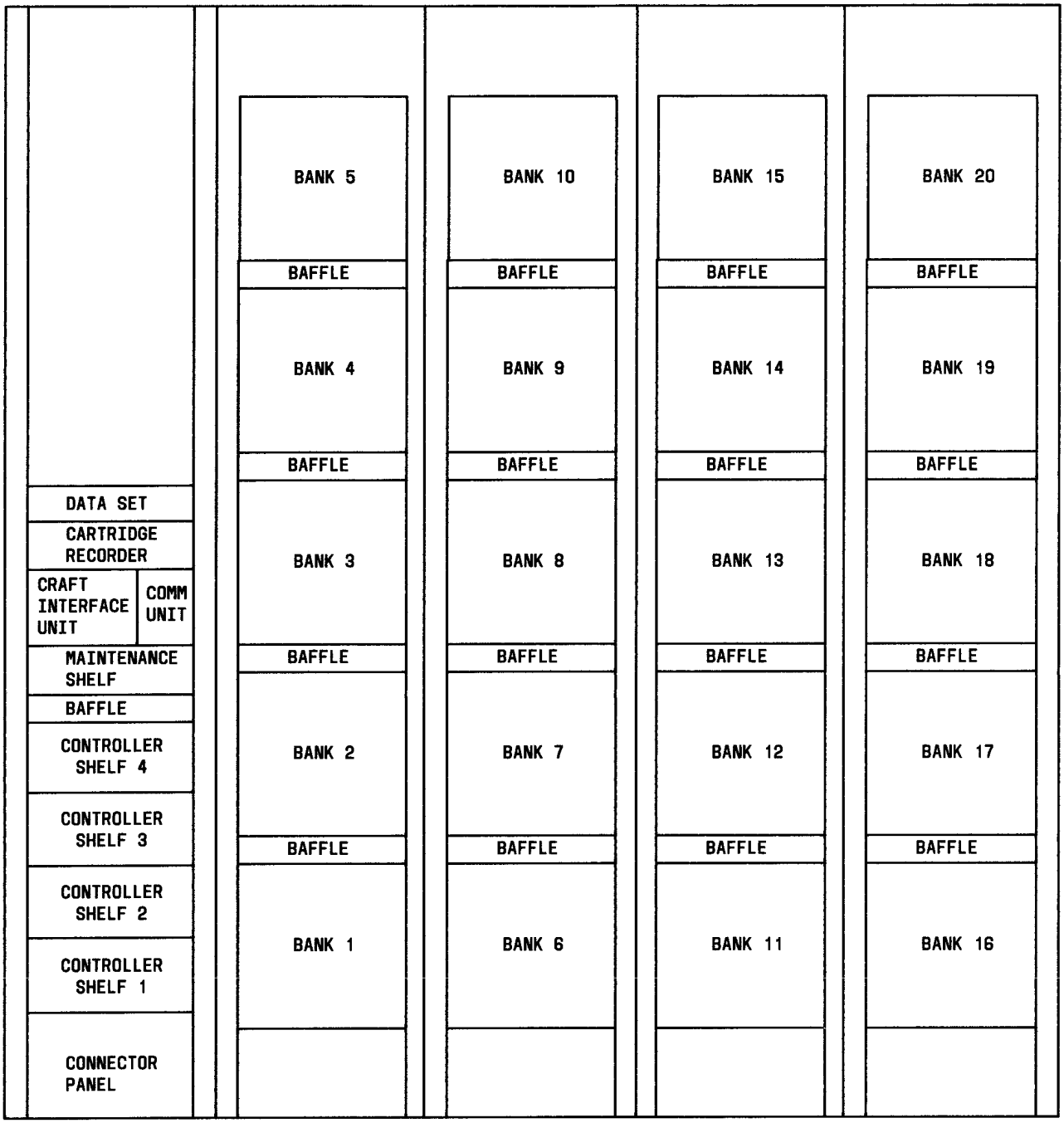

Fig. 3—D5 Digital Terminal System, 11-Foot 6-Inch Bays

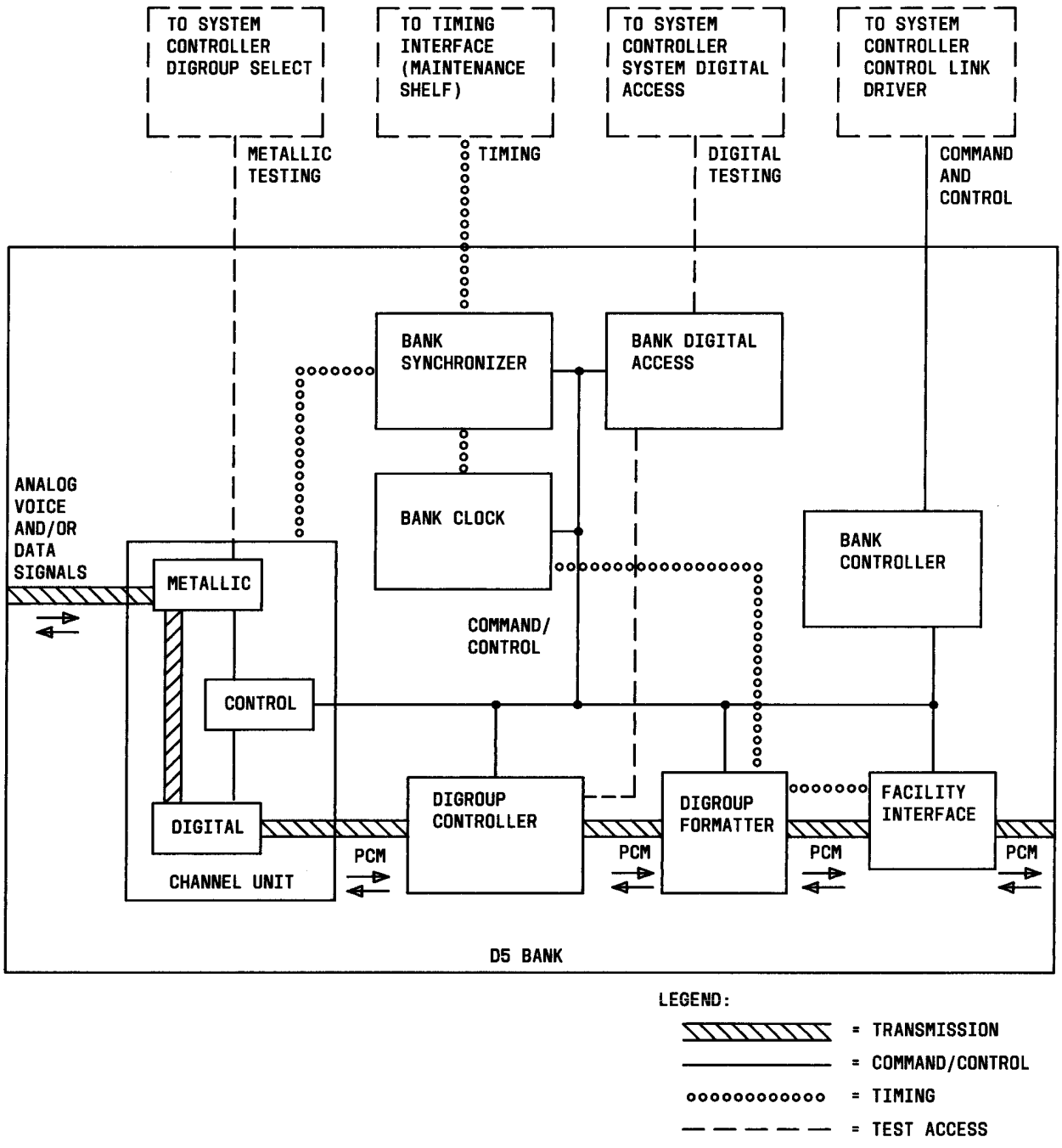

Fig. 4—D5 Channel Bank Block Diagram

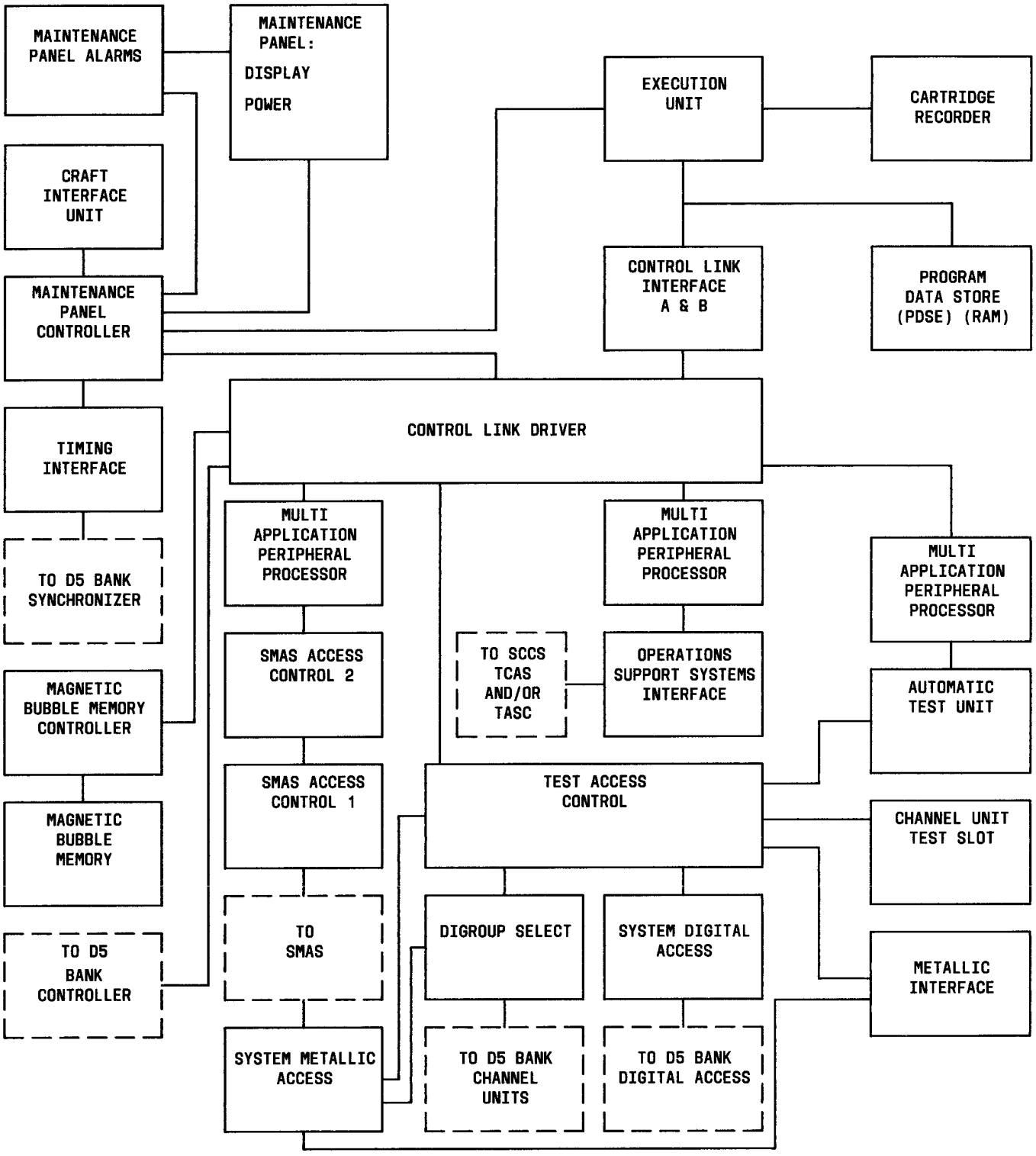

Fig. 5—D5 System Controller Block Diagram

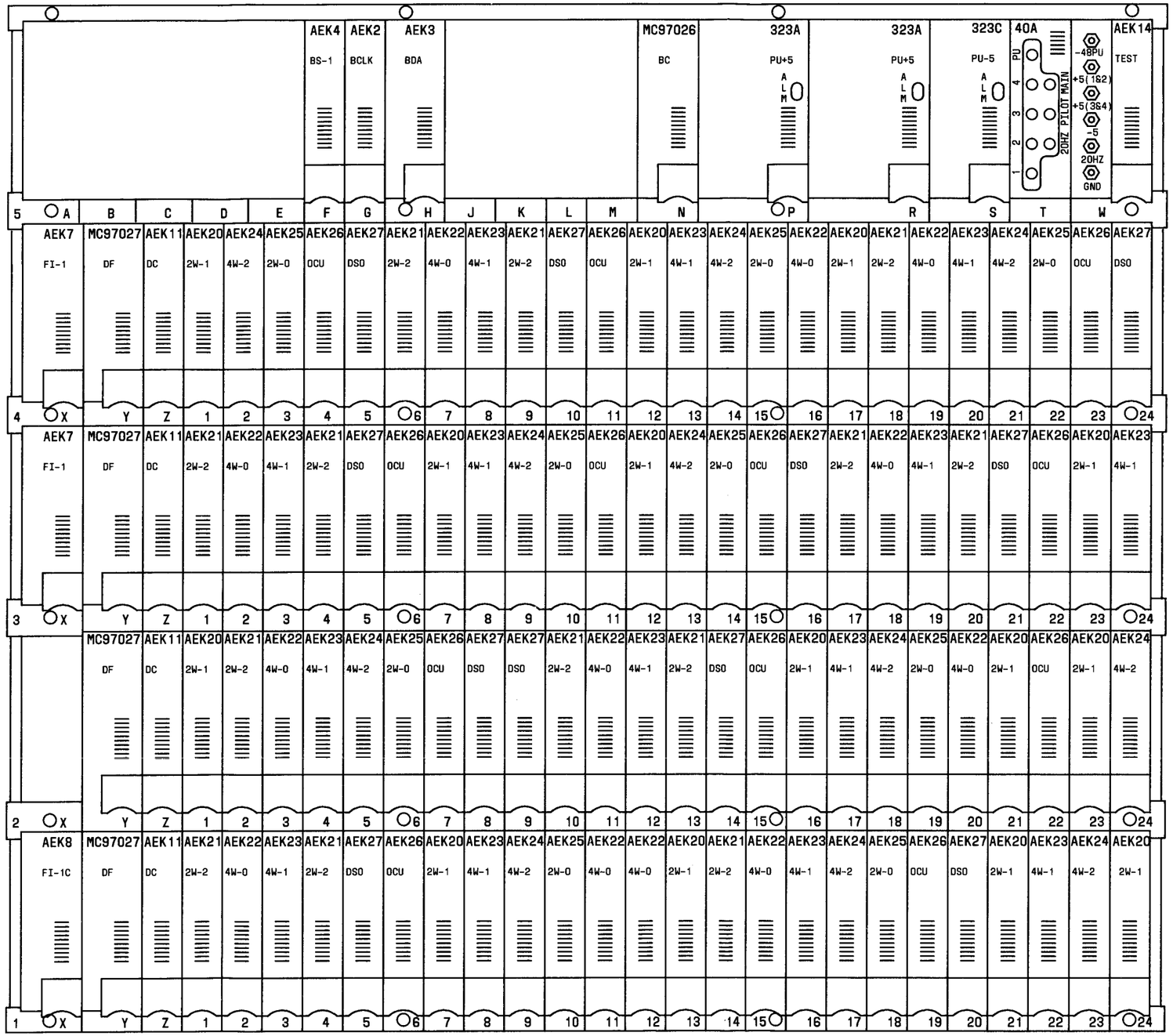

Fig. 6—D5 Channel Bank

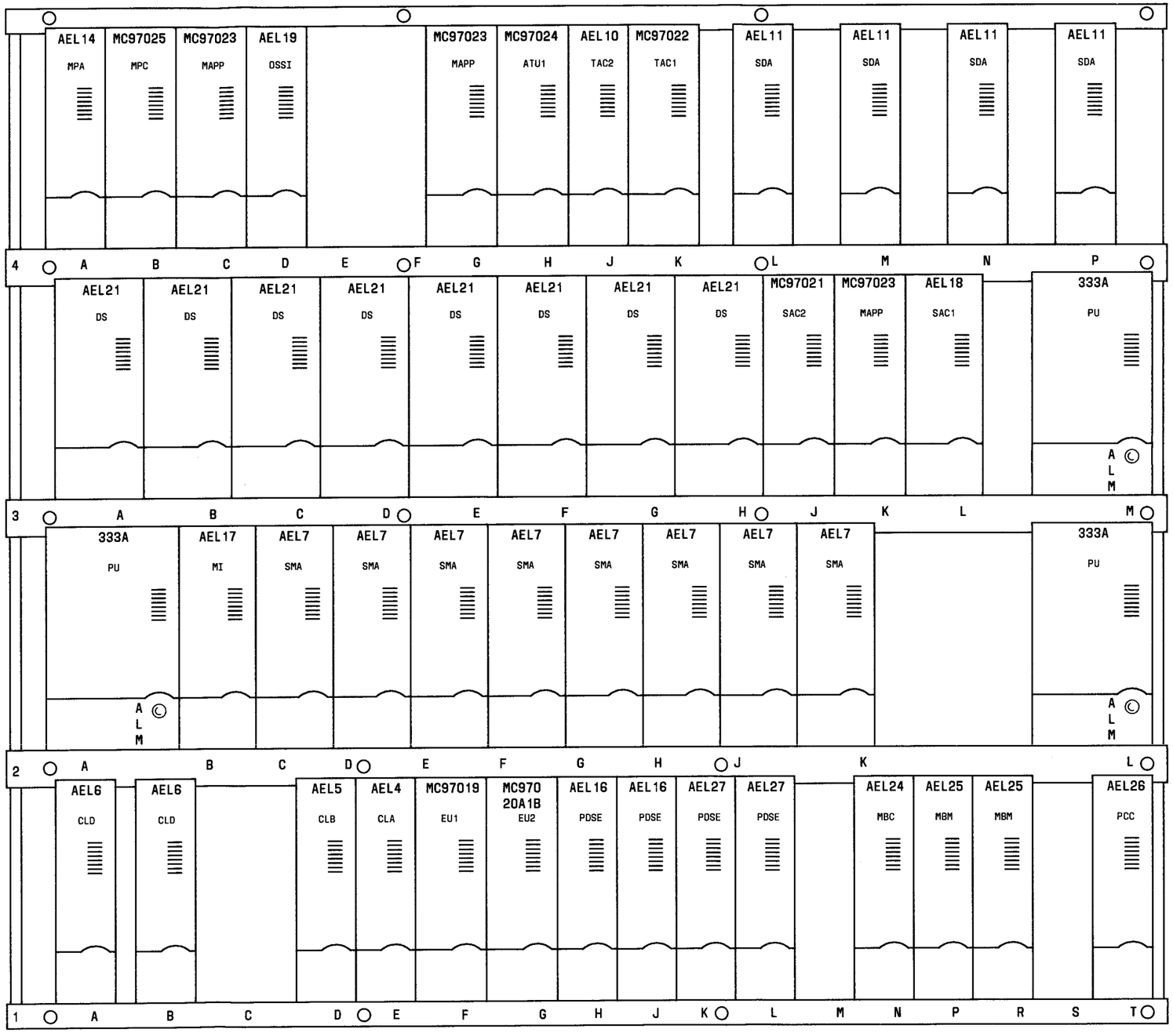

Fig. 7—D5 System Controller, Fully Equipped for 2.0 Software and With Latest Bubble Memory

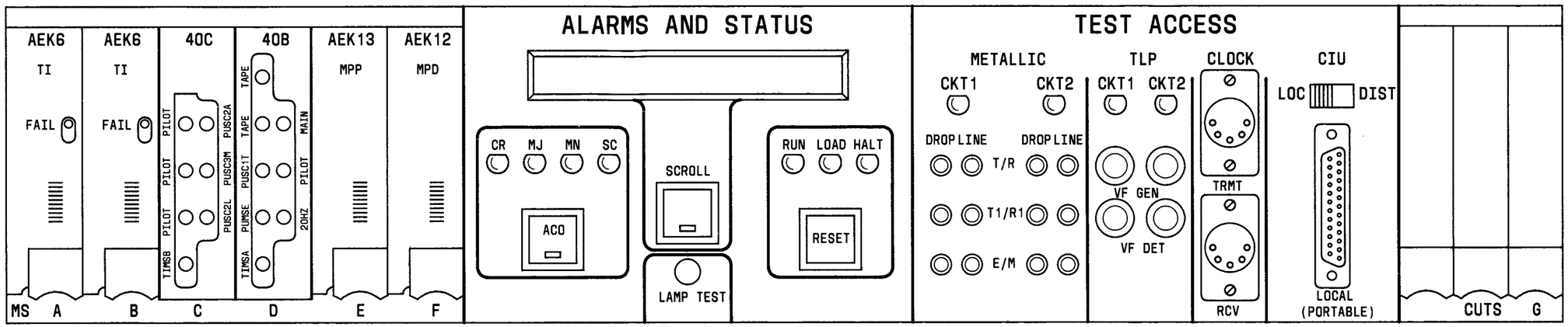

Fig. 8—D5 Maintenance Shelf